Oral radiology – DA and DH training

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Outline of the presentation

- General principles
- Panoramic radiography general principles
- CBCT general principles

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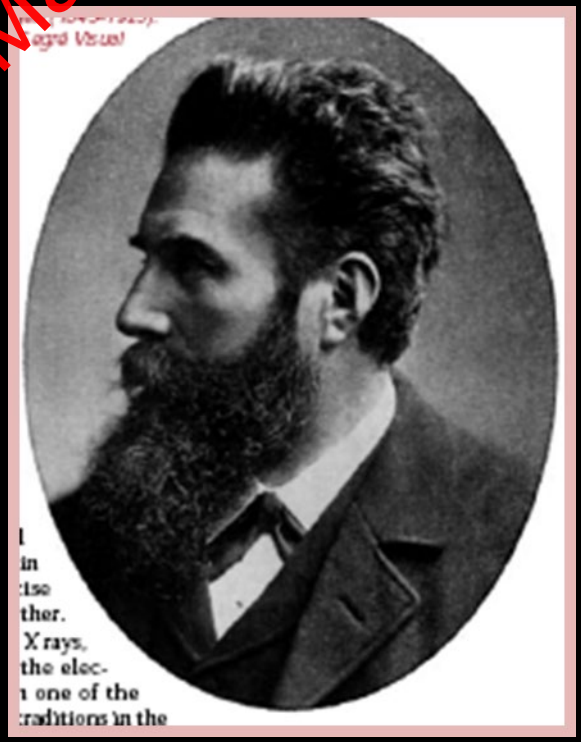
Oral radiology



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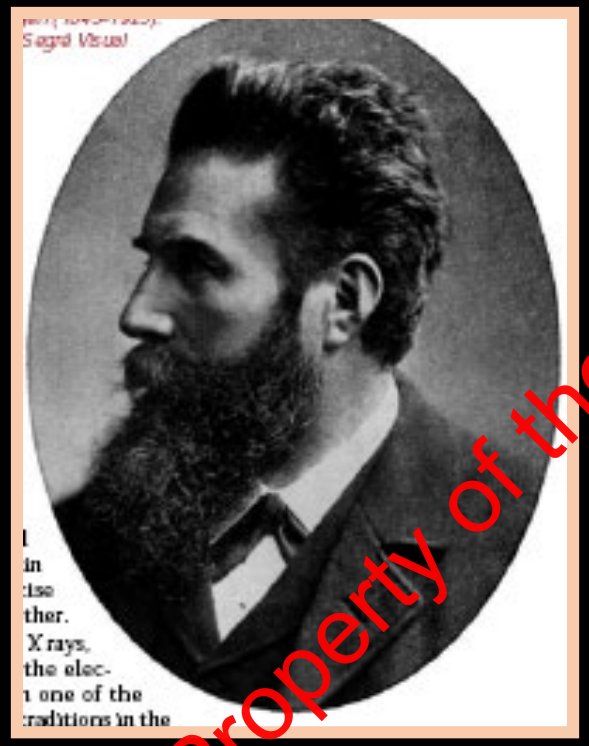
Discovery of x-rays



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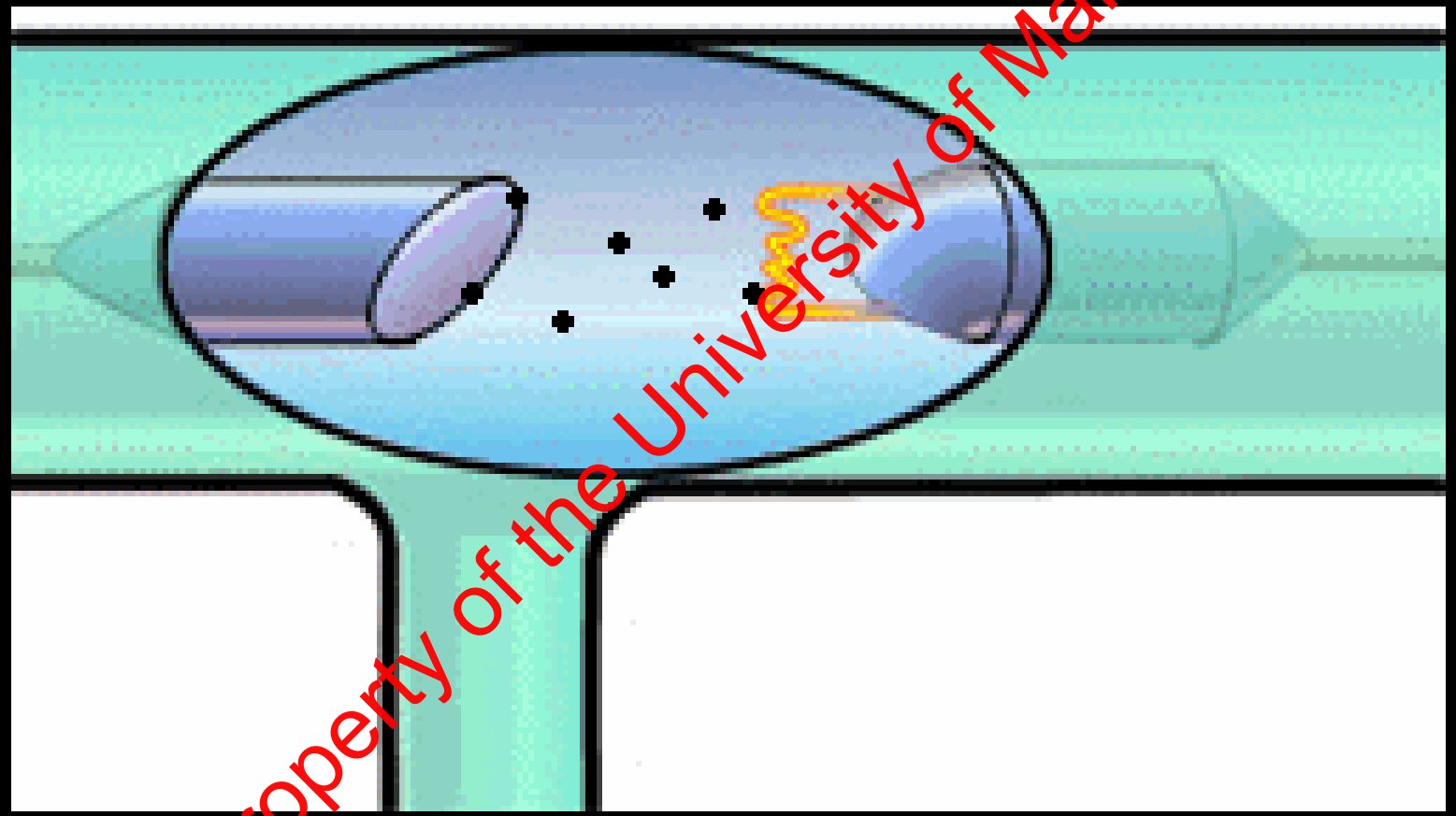
Schematic representation of x-ray production



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DENSITY

- The overall degree of darkening of an exposed film is referred to as radiographic density

$$D = \log \frac{\text{Incident light}}{\text{Transmitted light}}$$

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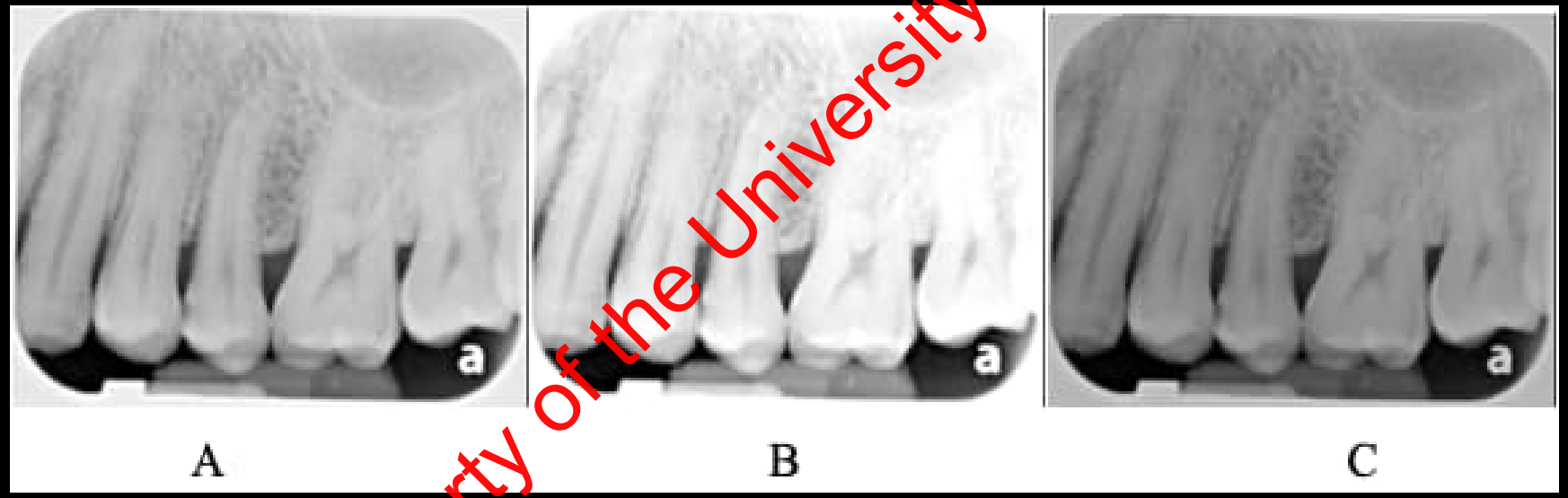
What is the difference between these images?



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RADIOGRAPHIC CONTRAST

- General term used to describe the range of densities on a radiograph
- ***High Contrast*** – ***Short Gray Scale*** of contrast.
- ***Low Contrast*** images – ***Long Gray Scale*** of contrast

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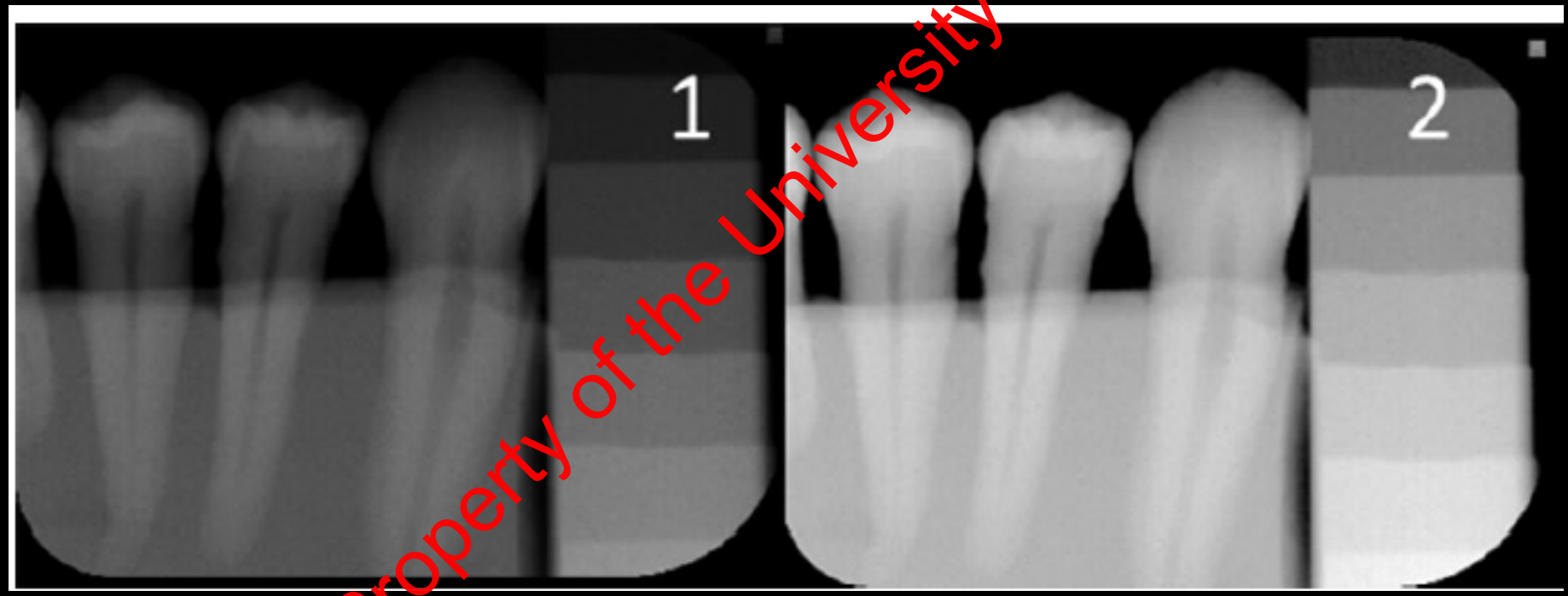
Commonly available exposure parameters

- kVp – Voltage – Contrast on the image (60-120 kVp)



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Dentomaxillofacial Radiology (2018) **47**, 20180100

SHARPNESS OF THE RADIOGRAPHIC IMAGE

- Geometric factors.
- Subject and its movement known as motional factors.
- Film factors.

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Which image has better sharpness?

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RADIOGRAPHIC NOISE

- Appearance of uneven density of a **uniformly exposed film**
- Primary causes
  - Radiographic mottle
  - Radiographic artifact

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ORTHOPANTOMOGRAM

- ORTHO - Orthodontics refers to the teeth
- PAN - Refers to the panoramic display of the teeth produced by the technique
- TOMOGRAM - X-ray image that is focused in a single plane of the patient which shows a sharp image; layers above and below it, being unsharp or blurred

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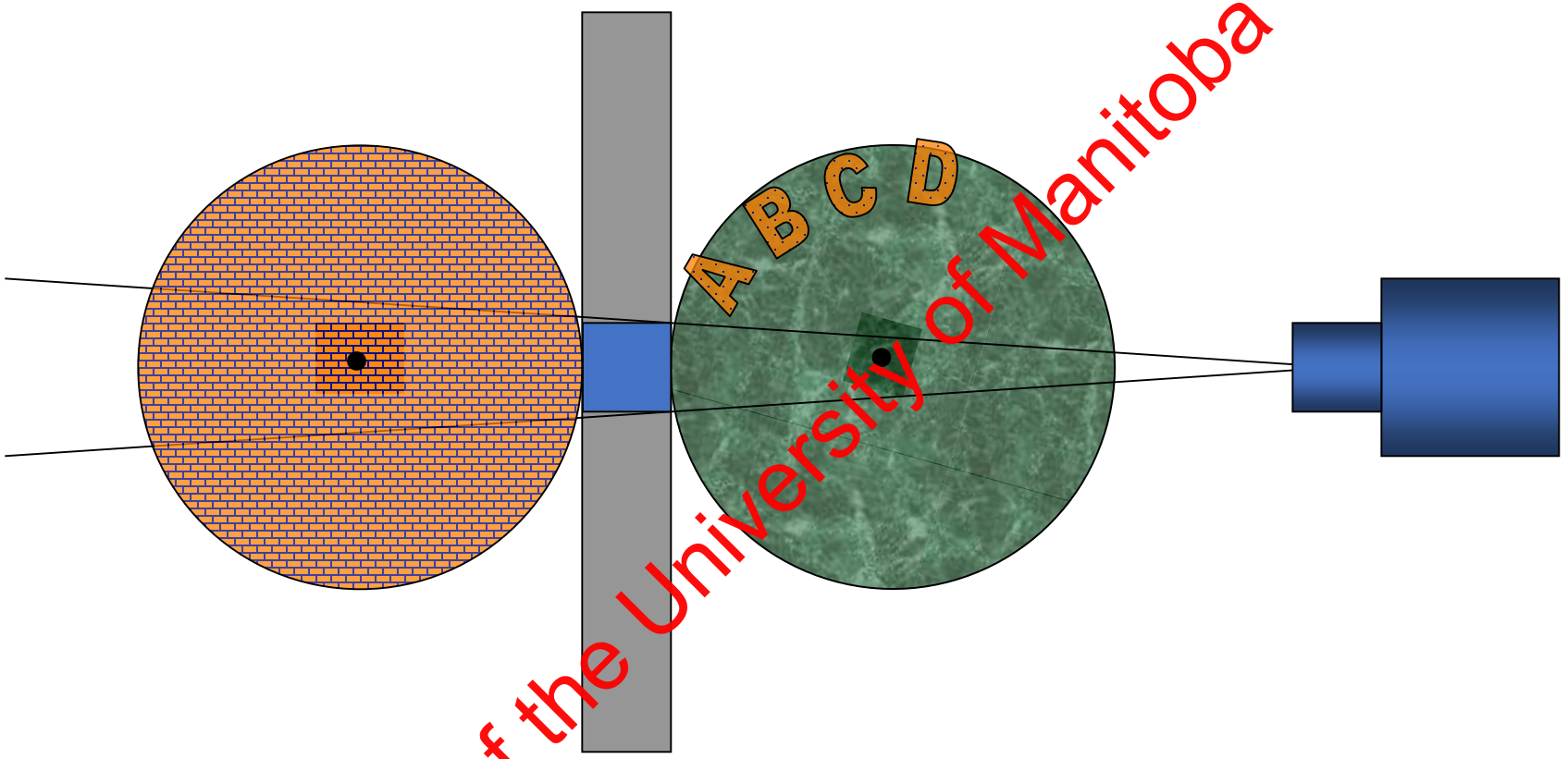
Working Principle



♪The radiopaque objects A,B,C,& D on disk-1 rotate past the slit and their images are recorded on disk-2 which we now consider as a film, which also moves past the slit at the same time

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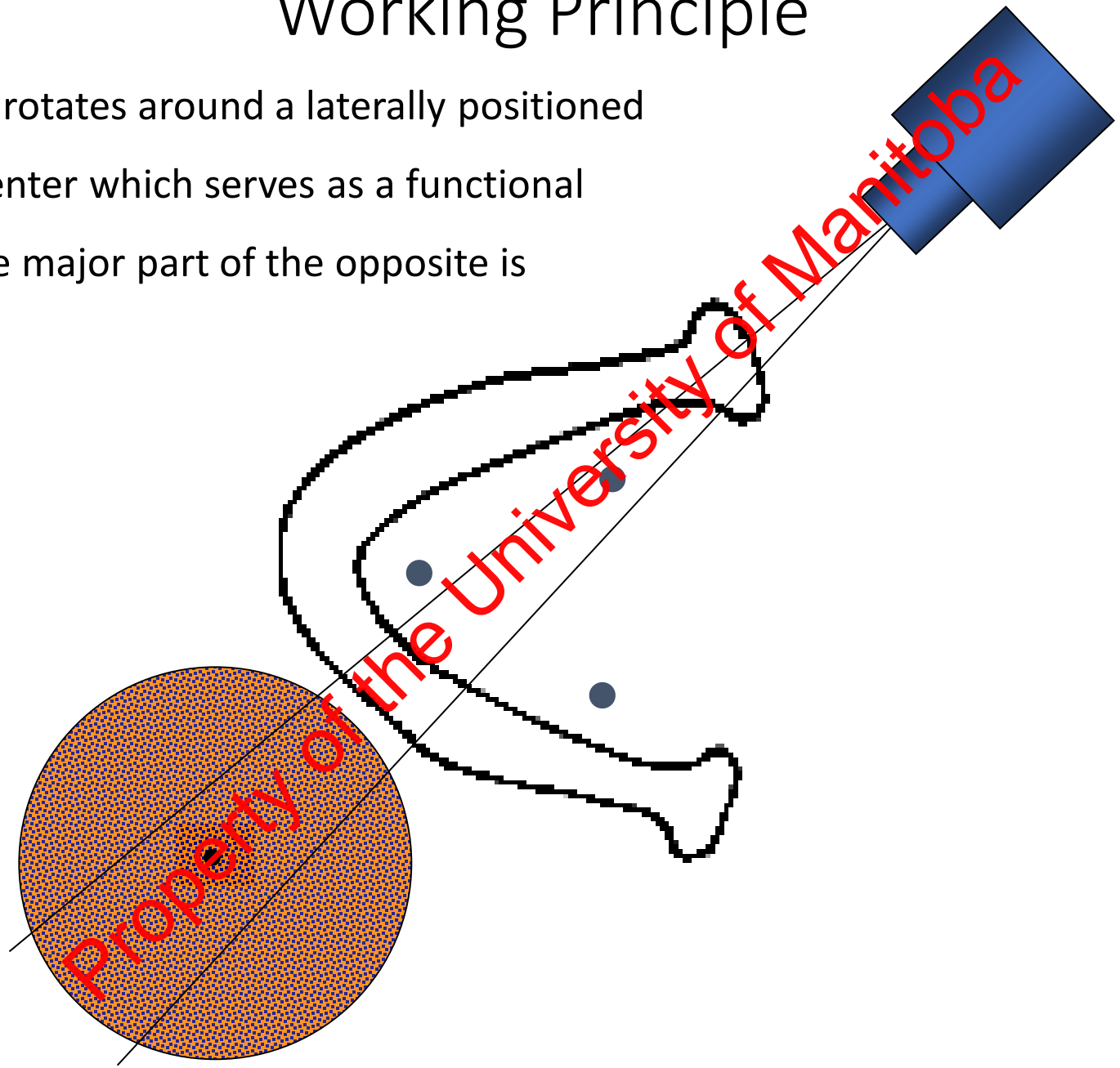
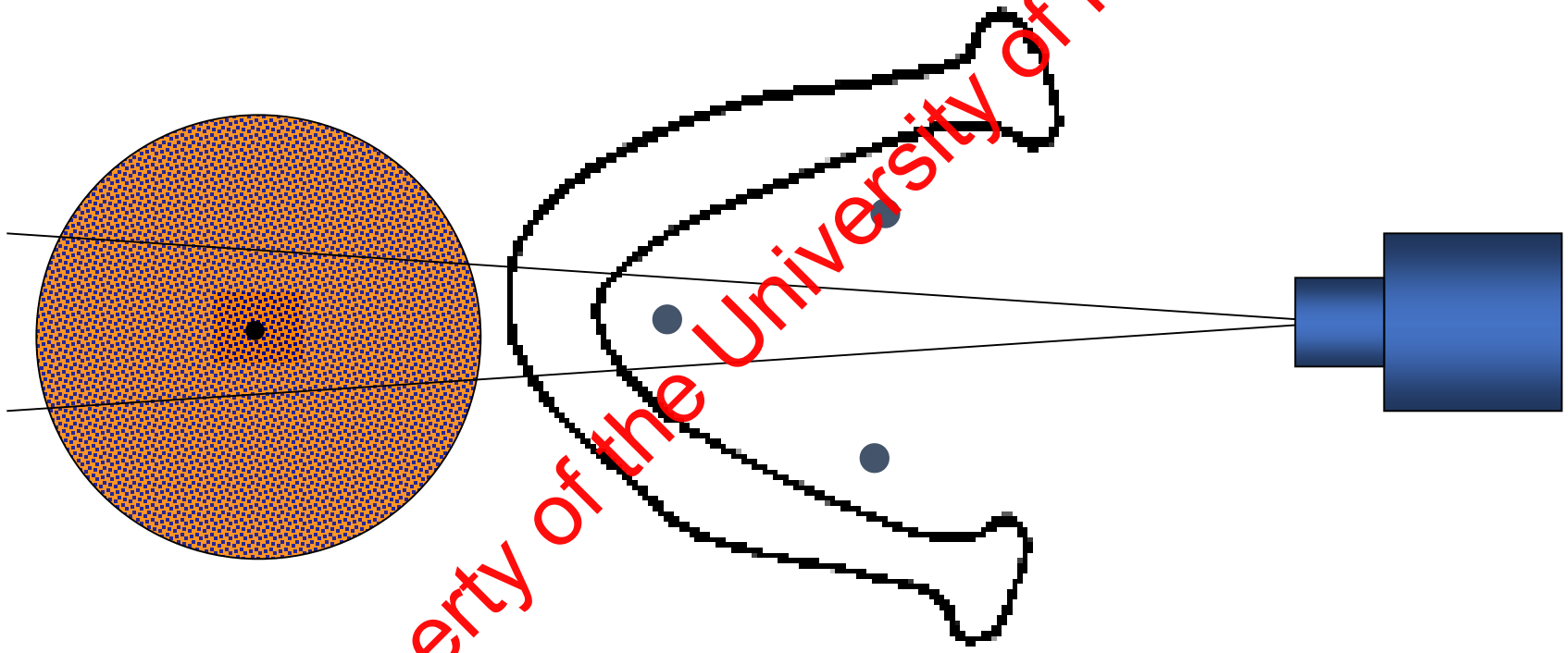
Working Principle

Beam first rotates around a laterally positioned rotation center which serves as a functional focus while major part of the opposite is exposed



Working Principle

The anterior region is now exposed with this second rotational center as the functional focus



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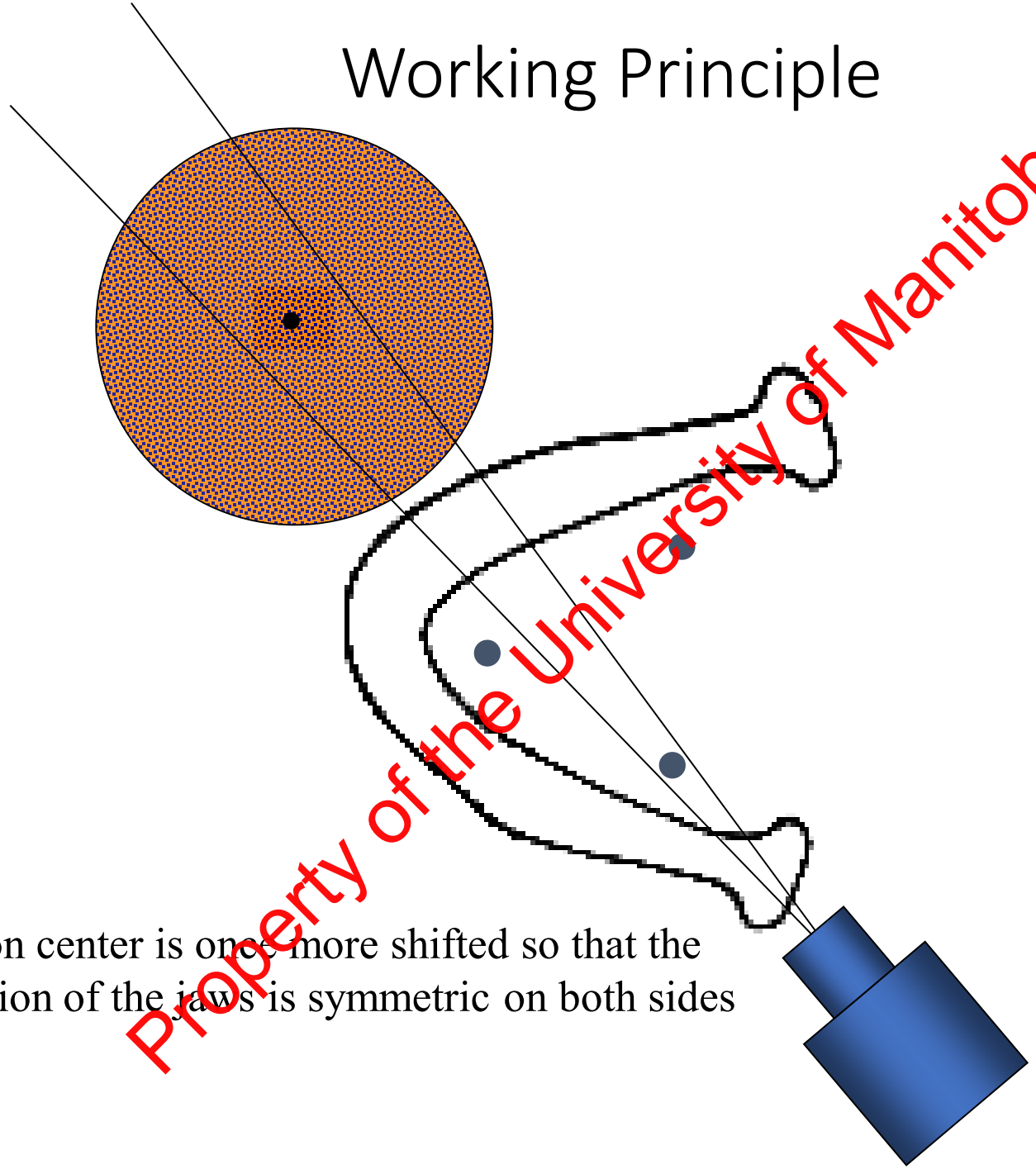
Working Principle



Rotation center is once more shifted so that the projection of the jaws is symmetric on both sides

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Focal trough (zone of sharpness)

- The focal trough is a three dimensional curved zone or image layer in which the structures are reasonably well defined on panoramic radiograph.
- It is curved in vertical plane because all machines use film that has its flat surface in vertical plane
- The shape of focal trough varies with the brand of equipment.
- Machines are designed to have zone, shaped like dental arch (*HORSE SHOE SHAPE*)

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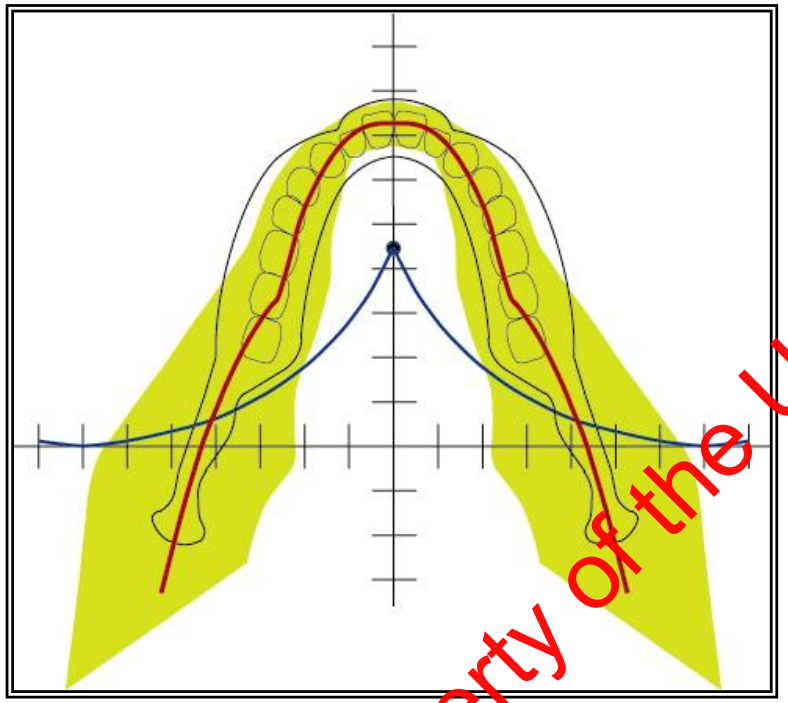
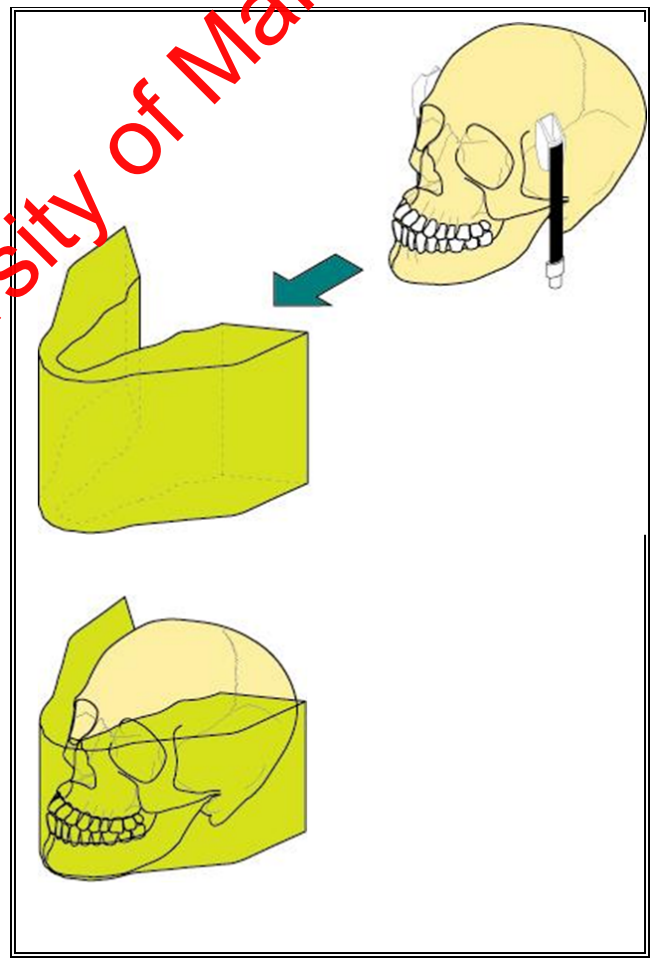
Focal trough





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Technical aspects

- Exposure time – 16.2 seconds
- Operating kVp 60-70 kV
- Operating current 1-7.5 mA
- Automatic exposure controls: The tube current (mA) controlled simultaneously based on the density of the patient.

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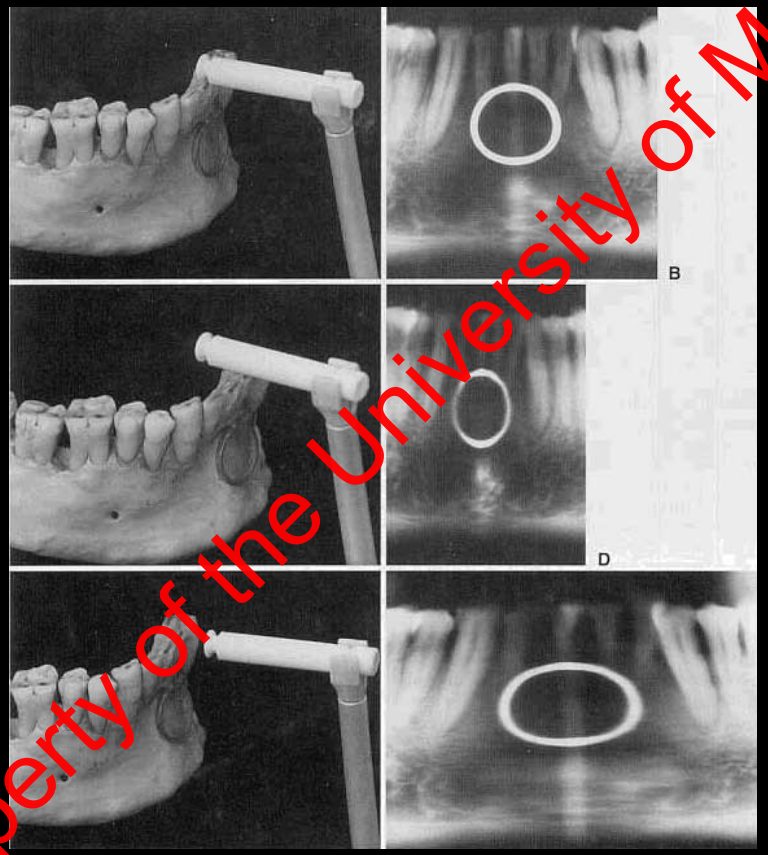
Illustration of focal trough



White and Pharoah's Oral Radiology , 6th Edition Principles and Interpretation

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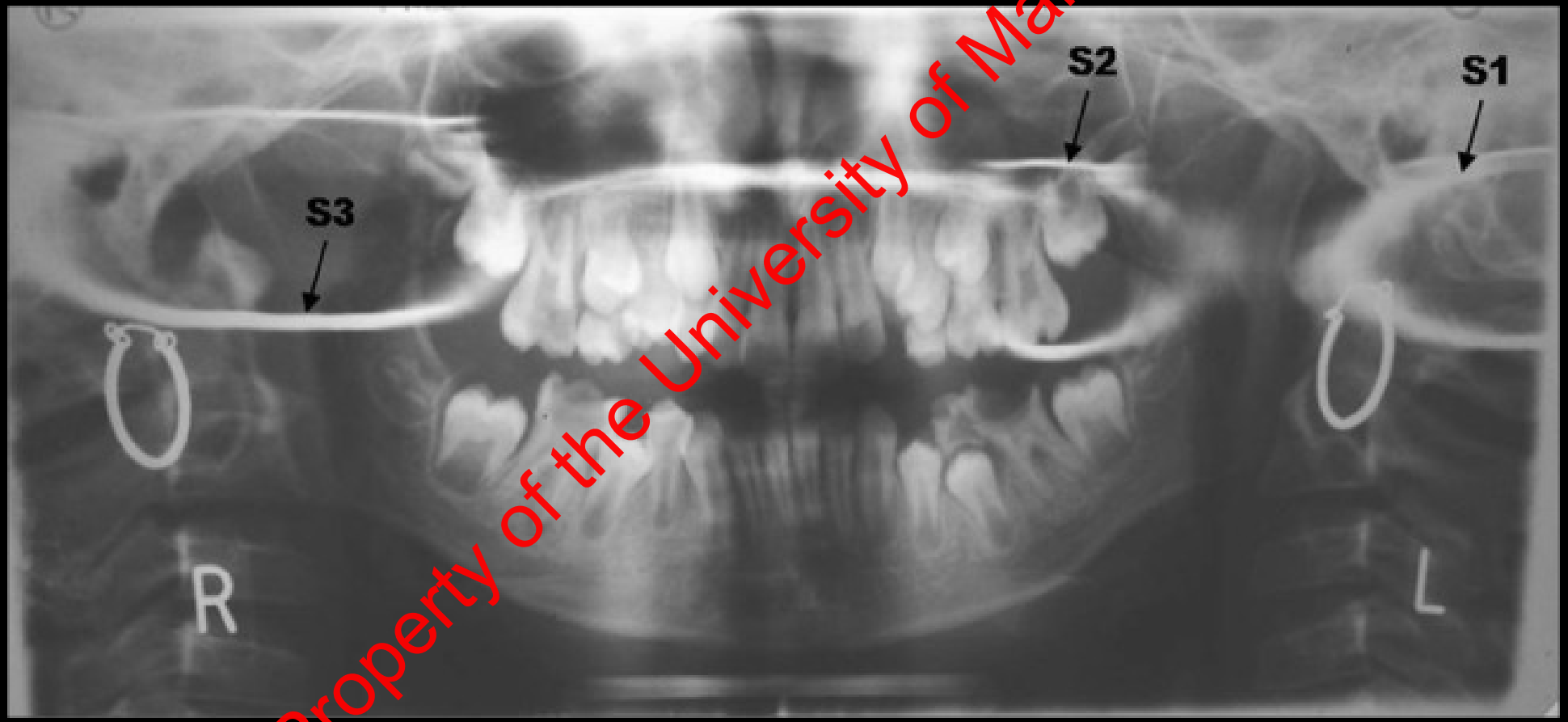
Panoramic ghost shadows



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Dentomaxillofac Radiol. 2011 Sep; 40(6): 397–399.

Illustration of ghost shadows

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Dentomaxillofac Radiol. 2011 Sep; 40(6): 397–399.

Tongue not on palate

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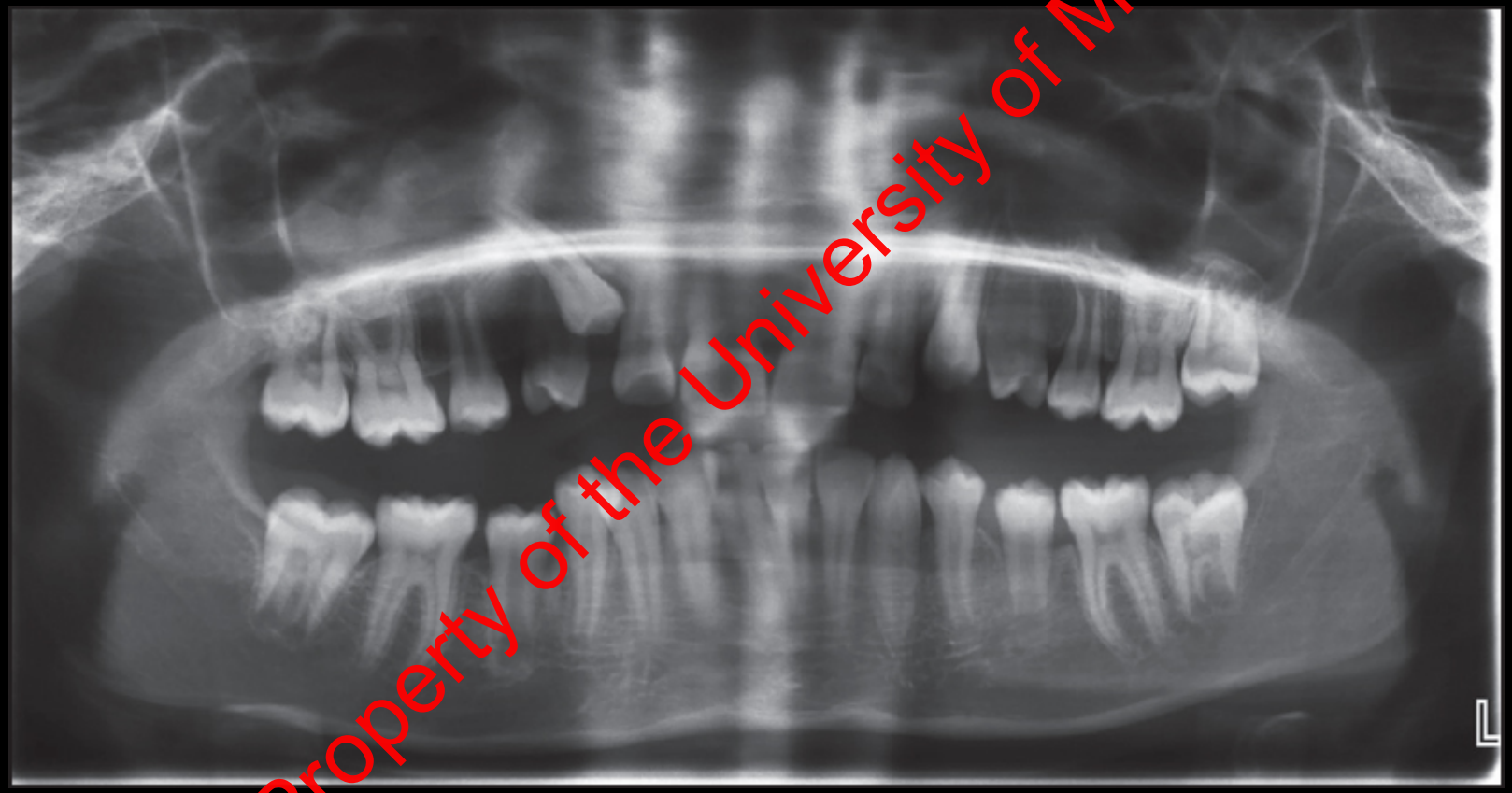
Too far back in focal trough



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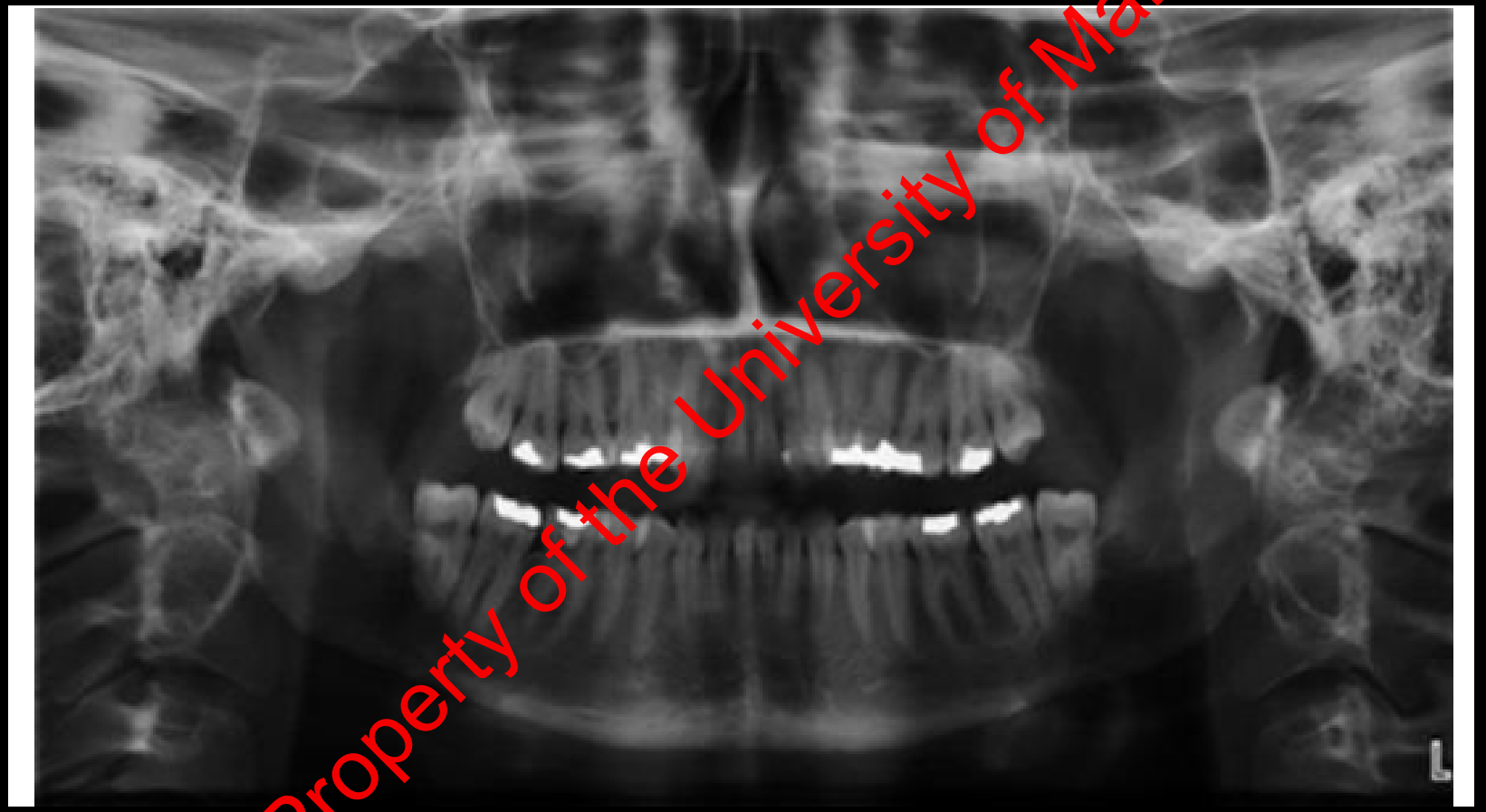
Too far forward



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CBCT general principles

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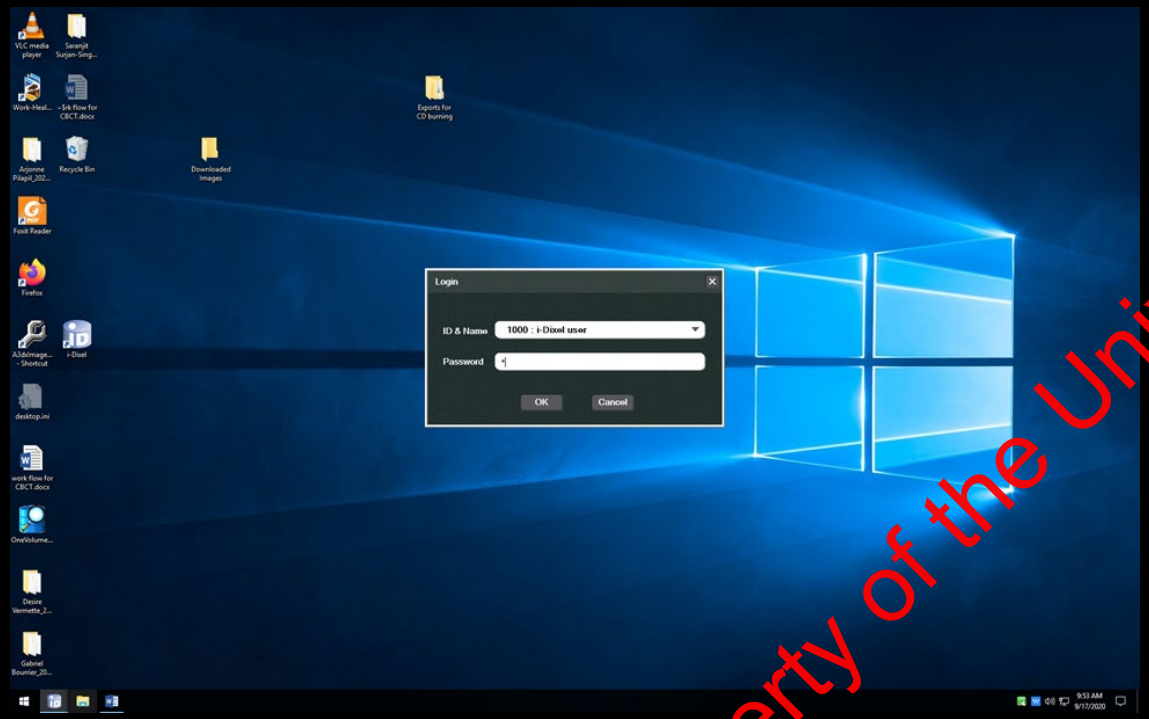
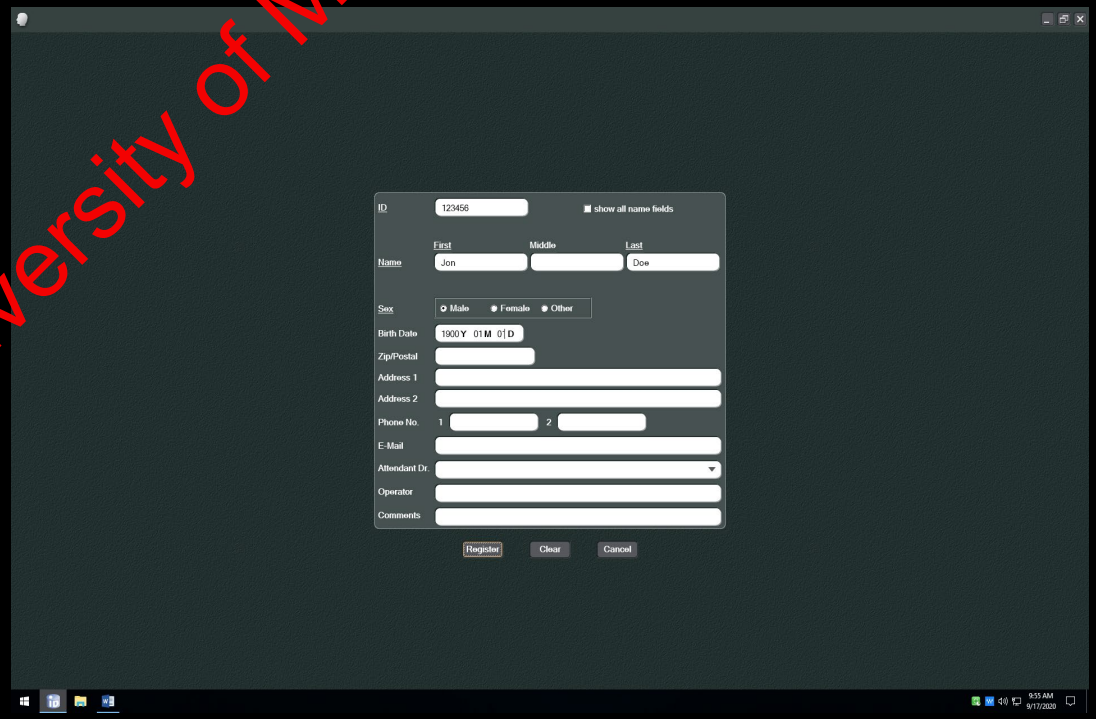
Patient positioning in the machine





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Key point : The software controls the CBCT hardware

Patient positioning in the machine

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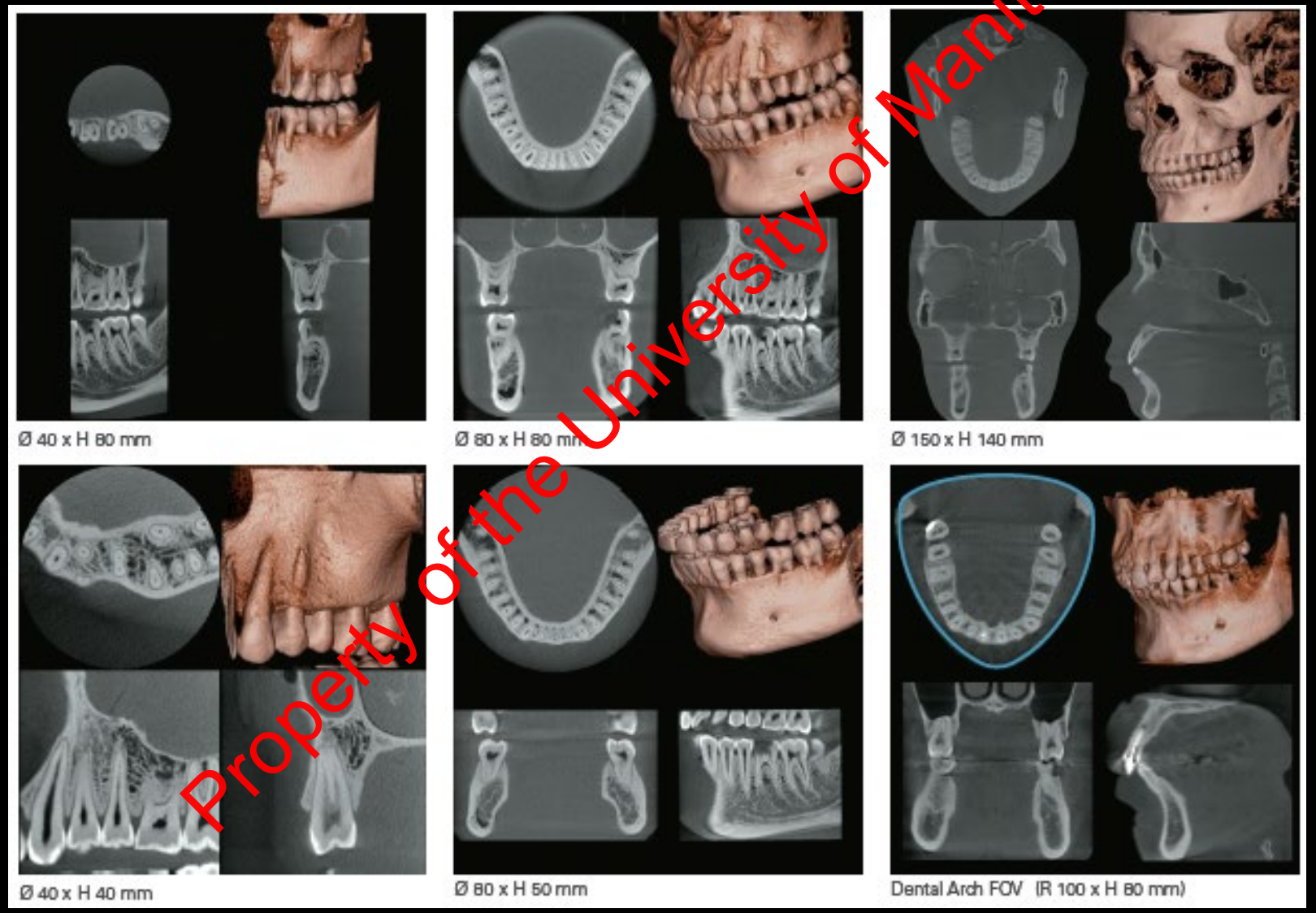
Different fields of view in CBCT machines



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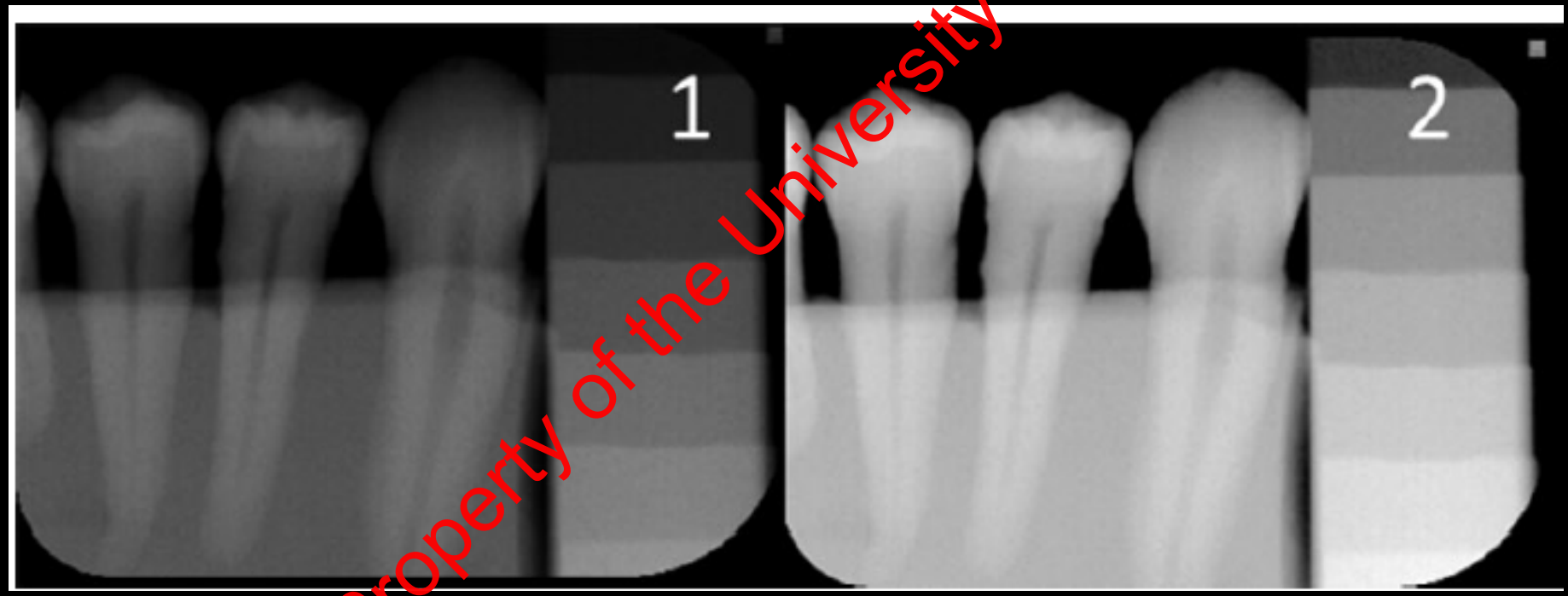
Commonly available exposure parameters

- kVp – Voltage – Contrast on the image (60-120 kVp)



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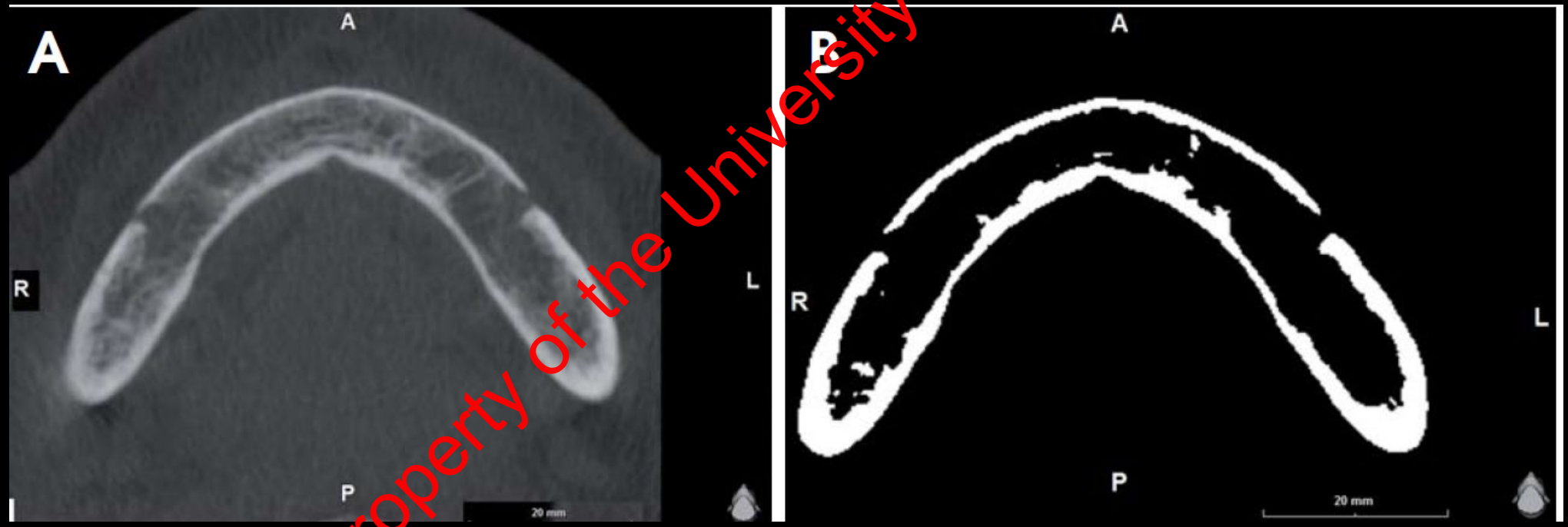
Commonly available exposure parameters

- Tube current and time (mAs) – (1-10 mA) (5.4 – 40 Sec) - Density



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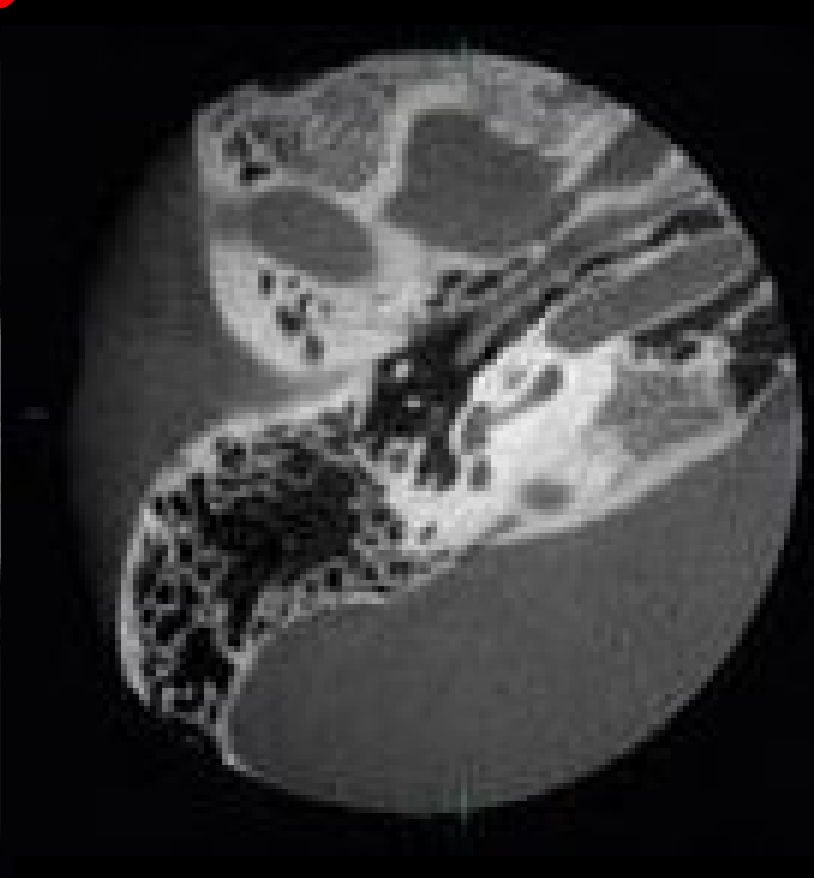
Commonly available exposure parameters

Hi Speed - 10.8/5.4 S



Hi resolution – 30.8/15.8 S

Hi Fidelity - 30.8/15.8 S

Standard – 17.5/9 S

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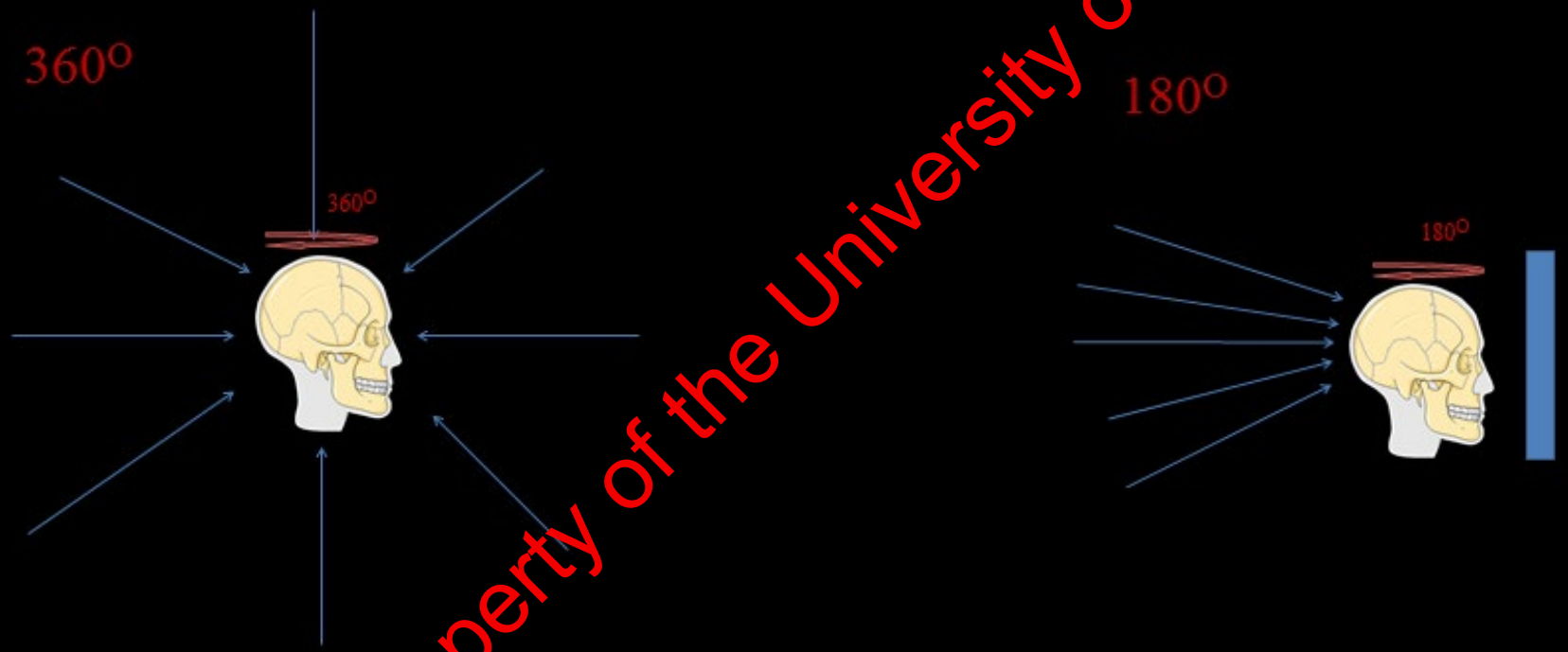
Tube rotation – Half and Full rotation scans



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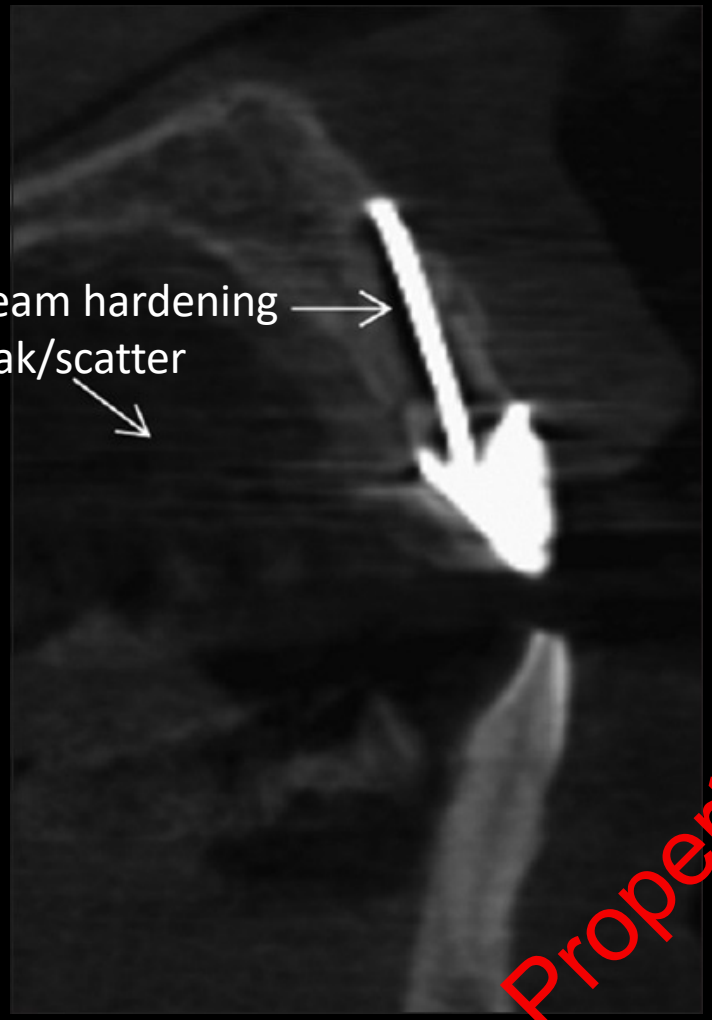
Common artifacts



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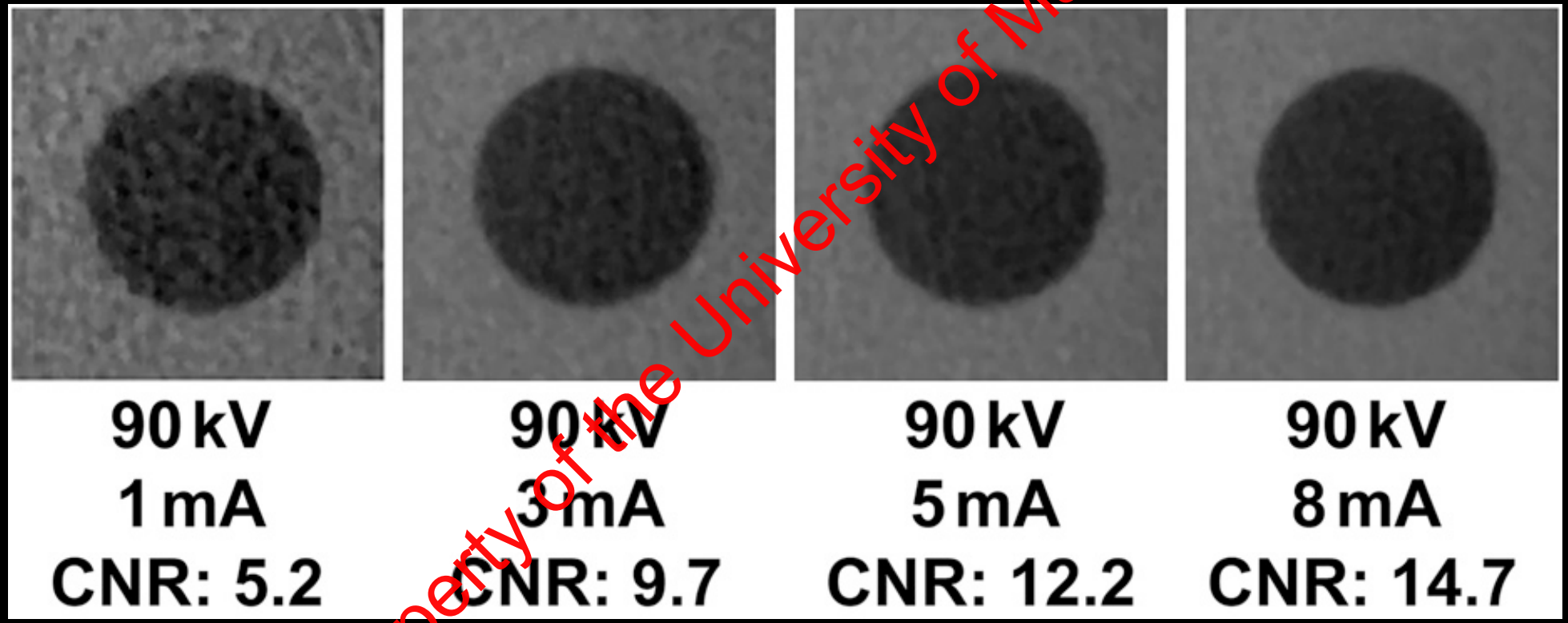
Setting optimum mA



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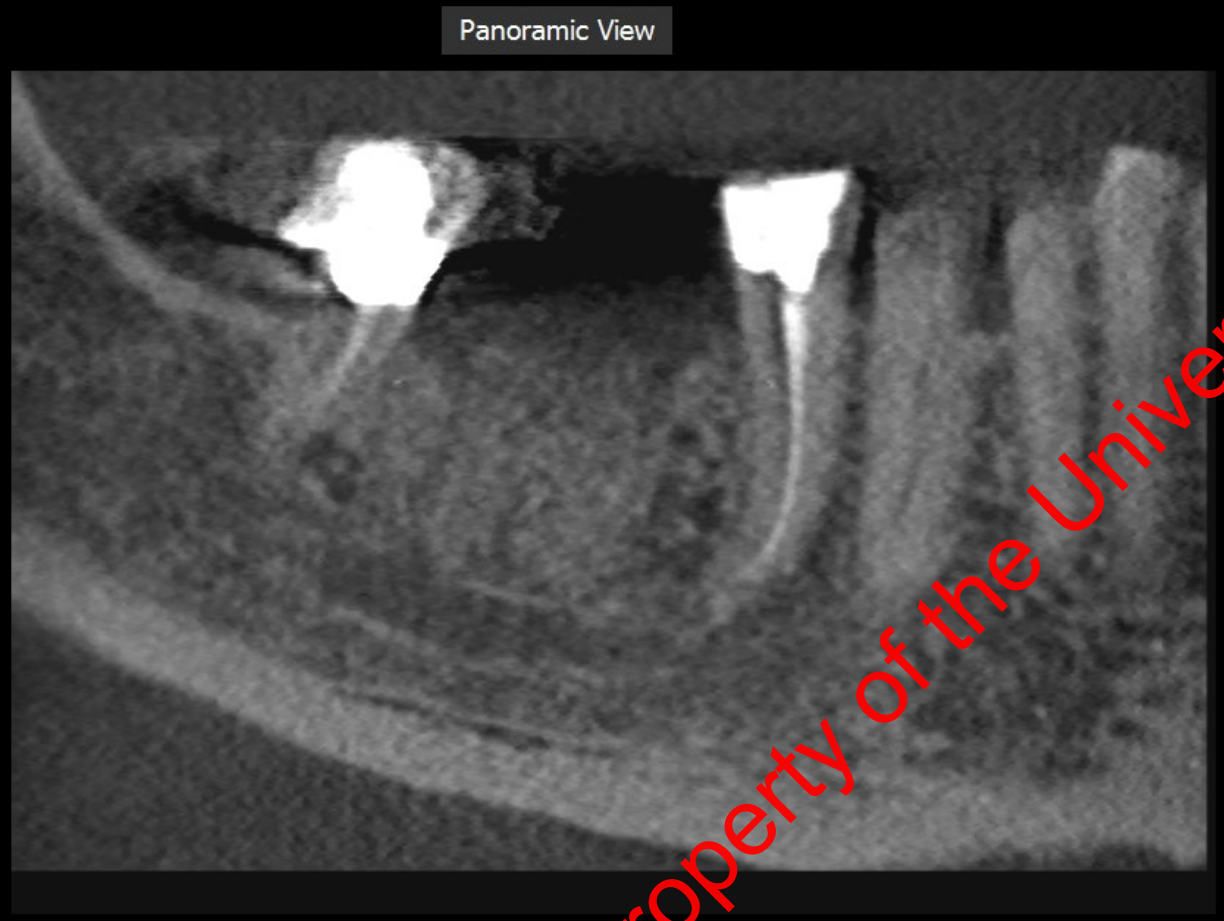
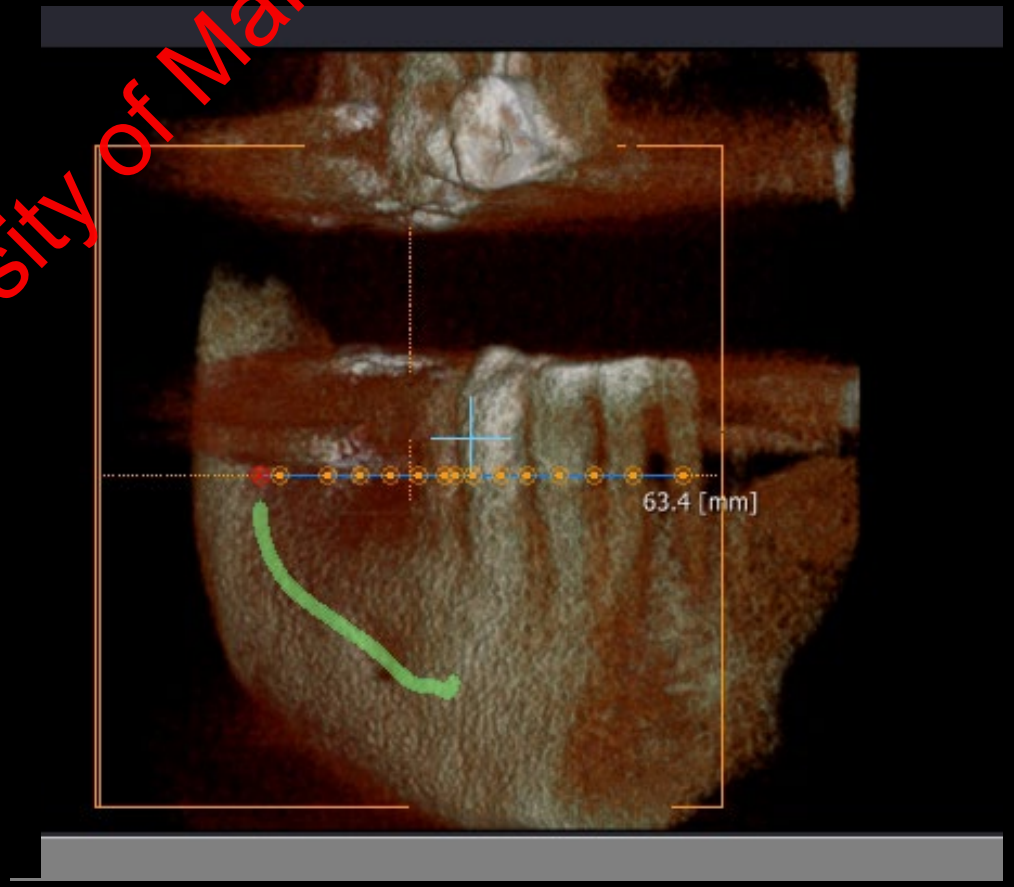
R Pauwels et al. Optimization in CBCT through mAs reduction DMFR 2015

Setting optimum mA





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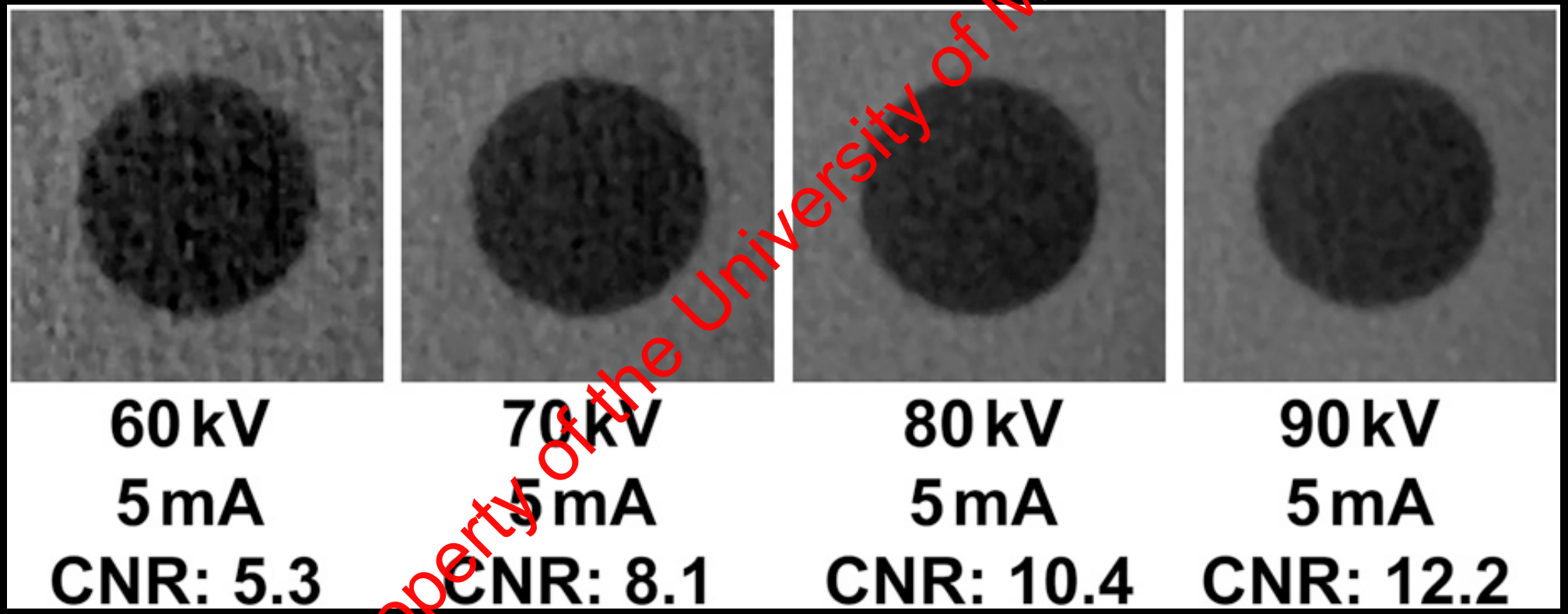
Setting optimal kVp



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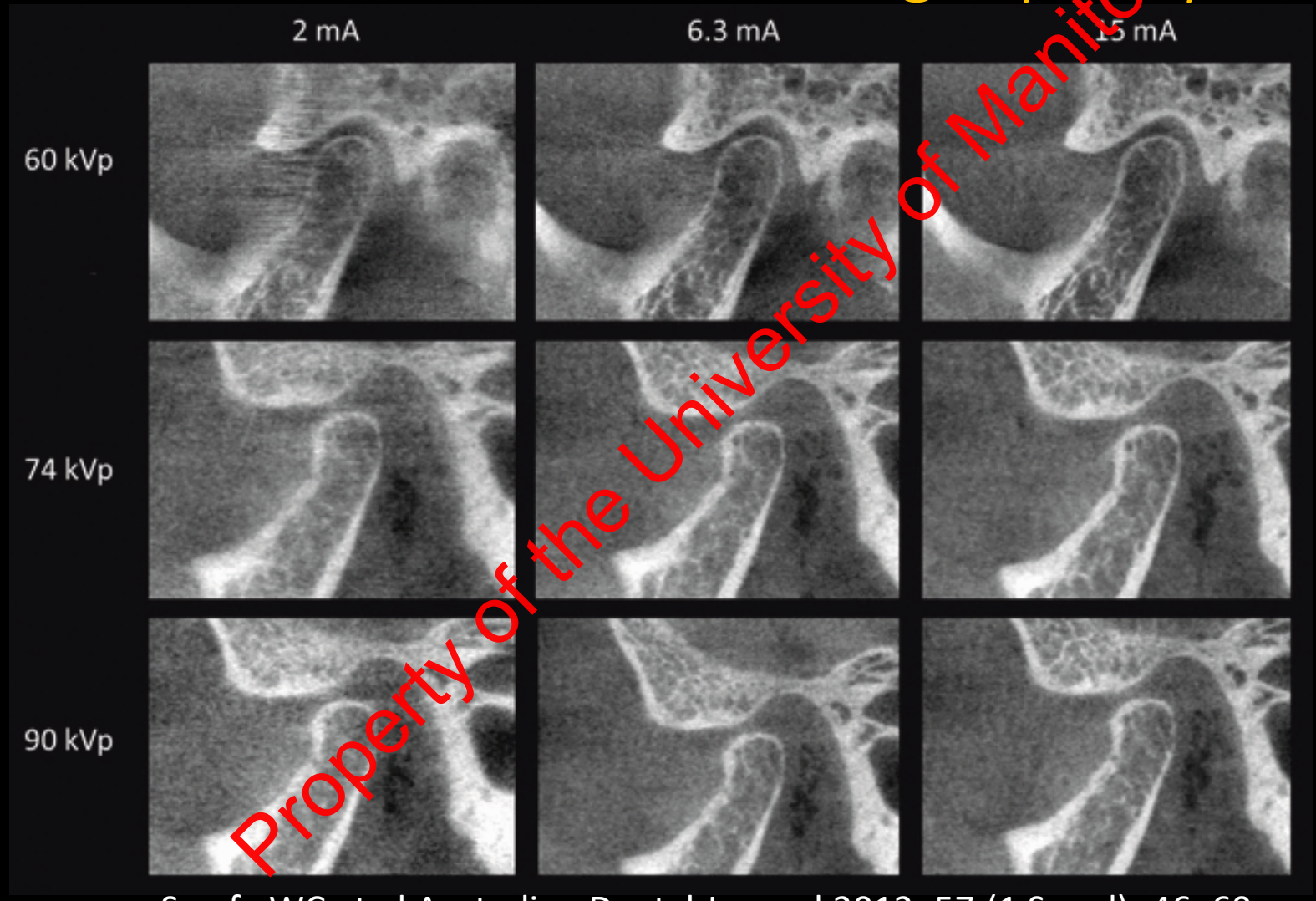
R Pauwels et al Optimal kVp in CBCT: CNR vs dose DMFR 2014

Effect of mA and image quality



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Scarfe WC et.al Australian Dental Journal 2012; 57:(1 Suppl): 46–60

Optimum exposure parameters – adults

- Highest KVp Always provides best image contrast
- Set mAs 10-20% less than the manufacturer recommendations
- Use half rotation scans if patients needs multiple scans
- *The most optimal contrast at a fixed dose was found at the highest available kVp setting.*
- *Image quality remained acceptable at exposure levels below the manufacturer's recommended setting.*

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Pauwels R et.al Dentomaxillofac Radiol. 2014 Jun; 43(5): 20140059.
Pauwels R et.al Dentomaxillofac Radiol. 2015;44(9):20150108

Optimal exposure parameters – pediatric population

- Optimum kVp – 70
- Optimum mAs – half of the adult dose
- Use quick scan/ultra low dose/half rotation scans
- Combining relatively low mAs (16) and kVp (70) with a small voxel size (180 µm) seems to be the optimal option under the tested conditions, due to the low effective dose associated to high image quality scores.

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Oenning AC et.al Scientific Reports volume 9, Article number: 5521 (2019)

Thank you

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